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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/736,444	12/15/2003	Antonio L.P. Rotondaro	TI-35029 (032350.B541)	3448
23494	7590	11/29/2004	EXAMINER	
TEXAS INSTRUMENTS INCORPORATED			DANG, TRUNG Q	
P O BOX 655474, M/S 3999			ART UNIT	
DALLAS, TX 75265			PAPER NUMBER	
			2823	

DATE MAILED: 11/29/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

AK

<b>Office Action Summary</b>	<b>Application No.</b>	<b>Applicant(s)</b>	
	10/736,444	ROTONDARO ET AL.	
	<b>Examiner</b>	<b>Art Unit</b>	
	Trung Dang	2823	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --  
**Period for Reply**

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

**Status**

- 1) ☐ Responsive to communication(s) filed on \_\_\_\_.
- 2a) ☐ This action is **FINAL**.                      2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

**Disposition of Claims**

- 4) ☒ Claim(s) 1-20 is/are pending in the application.  
     4a) Of the above claim(s) 19 is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 1-18 and 20 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_ are subject to restriction and/or election requirement.

**Application Papers**

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 15 December 2003 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.  
     Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
     Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

**Priority under 35 U.S.C. § 119**

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).  
     a) ☐ All    b) ☐ Some \* c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- \* See the attached detailed Office action for a list of the certified copies not received.

**Attachment(s)**

- |  |   |
|--|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892)                        | 4) <input type="checkbox"/> Interview Summary (PTO-413)                     |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948)               | Paper No(s)/Mail Date. ____   |
| 3) <input checked="" type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152) |
| Paper No(s)/Mail Date <u>12/15/03</u> .  | 6) <input type="checkbox"/> Other: ____                                     |

**DETAILED ACTION**

***Election/Restrictions***

1. Restriction to one of the following inventions is required under 35 U.S.C. 121:
  - I. Claims 1-18 and 20, drawn to a method of fabricating a semiconductor structure, classified in class 438, subclass 778.
  - II. Claim 19, drawn to a system of fabricating a semiconductor substrate, classified in class 118, subclass 715.

The inventions are distinct, each from the other because of the following reasons:

2. Inventions I and II are related as process and apparatus for its practice. The inventions are distinct if it can be shown that either: (1) the process as claimed can be practiced by another materially different apparatus or by hand, or (2) the apparatus as claimed can be used to practice another and materially different process. (MPEP § 806.05(e)). In this case, the apparatus as claimed can be used to practice another and materially different process, for example, the claimed means for incorporating nitrogen into the dielectric layer could be used to incorporate oxygen into a non-stoichiometry silicon nitride layer, wherein the degree of the non-stoichiometry corresponding to an oxygen profile associated with the dielectric layer.
3. Because these inventions are distinct for the reasons given above and have acquired a separate status in the art as shown by their different classification, restriction for examination purposes as indicated is proper.

4. Because these inventions are distinct for the reasons given above and have acquired a separate status in the art because of their recognized divergent subject matter, restriction for examination purposes as indicated is proper.

5. Because these inventions are distinct for the reasons given above and the search required for Group I invention is not required for Group II invention, restriction for examination purposes as indicated is proper.

6. During a telephone conversation with Keiko Ichiye on 11/05/04 a provisional election was made with traverse to prosecute the invention of the Group I, claims 1-18 and 20. Affirmation of this election must be made by applicant in replying to this Office action. Claims 19 is withdrawn from further consideration by the examiner, 37 CFR 1.142(b), as being drawn to a non-elected invention.

7. Applicant is reminded that upon the cancellation of claims to a non-elected invention, the inventorship must be amended in compliance with 37 CFR 1.48(b) if one or more of the currently named inventors is no longer an inventor of at least one claim remaining in the application. Any amendment of inventorship must be accompanied by a request under 37 CFR 1.48(b) and by the fee required under 37 CFR 1.17(i).

*Claim Rejections - 35 USC § 102*

8. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(e) the invention was described in a patent granted on an application for patent by another filed in the United States before the invention thereof by the applicant for patent, or on an international application by another who has fulfilled the requirements of paragraphs (1), (2), and (4) of section 371(c) of this title before the invention thereof by the applicant for patent.

The changes made to 35 U.S.C. 102(e) by the American Inventors Protection Act of 1999 (AIPA) and the Intellectual Property and High Technology Technical Amendments Act of 2002 do not apply when the reference is a U.S. patent resulting directly or indirectly from an international application filed before November 29, 2000. Therefore, the prior art date of the reference is determined under 35 U.S.C. 102(e) prior to the amendment by the AIPA (pre-AIPA 35 U.S.C. 102(e)).

9. Claims 1-3, 4, 8-13, 14 and 18 are rejected under 35 U.S.C. 102(e) as being anticipated by Jeon (US 6,790,755).

The reference anticipates the claimed invention in that it discloses a method of fabricating a semiconductor device comprising:

depositing on a semiconductor substrate a dielectric material of silicon oxide including non-stoichiometric variations of the exact stoichiometric formula identified by said oxide, the non-stoichiometric variations is controlled by selection and control of the conditions under which the silicon oxide are

deposited (col. 4, lines 9-12; col. 5, lines 1-23; col. 8, lines 1-2; col. 10, lines 57-65 and col. 14, lines 28-31);

incorporating nitrogen into the non-stoichiometric silicon oxide to produce a nitrogenated silicon oxide layer having a nitrogen concentration of about zero weight percent to about 10 weight percent (col. 14, lines 43-58).

Note that the definition of stoichiometric variations of the silicon oxide of the reference reads on the claimed “establishing a non- stoichiometry associated with a dielectric layer, the non-stoichiometry associated with a degree”, and the percentage of nitrogen within the aforementioned range incorporated in the non-stoichiometric silicon oxide reads on the claimed “ the degree of the non- stoichiometry corresponding to a nitrogen profile associated with the dielectric layer”.

For claims 2, 3, 8, 12, 13, and 18, since the claims do not specifically call for the exact proportion of silicon relative to oxygen of the dielectric layer, the definition of stoichiometric variations of the silicon oxide of the reference as noted above reads on the claimed limitation regarding the determining (or calculating) a proportion of silicon relative to oxygen of the dielectric layer.

For claims 3 and 13, see col. 11, lines 15-17 for the deposition of the silicon oxide by exposing the substrate to a gas flow comprising a precursor and an oxidizer.

For claims 4 and 14, since the claims employ “comprising” format which do not exclude other intermediate steps, the disclosure at col. 11, lines 21-24 where sub-layers of silicon oxide are repeatedly deposited reads on the claimed limitation.

For claims 9-10, see col. 9, lines 41-43 for the thickness of the non-stoichiometric silicon oxide layer.

10. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

11. Claims 1-2, 8-12, and 18 are rejected under 35 U.S.C. 102(e) as being anticipated by Colombo et al. (US 2003/0109146 cited by applicants)

The applied reference has a common inventor with the instant application. Based upon the earlier effective U.S. filing date of the reference, it constitutes prior art under 35 U.S.C. 102(e). This rejection under 35 U.S.C. 102(e) might be overcome either by a showing under 37 CFR 1.132 that any invention disclosed but not claimed in the reference was derived from the inventor of this application and is thus not the invention “by another,” or by an appropriate showing under 37 CFR 1.131.

With reference to Fig. 3, the reference anticipates the claims in that it discloses a method of fabricating a semiconductor device, comprising:

establishing a non-stoichiometry associated with a dielectric layer, the non-stoichiometry associated with a degree, the degree of the non-stoichiometry corresponding to a nitrogen profile associated with the dielectric layer;

controlling deposition of the dielectric layer outwardly from a substrate to substantially yield the established non-stoichiometry of the dielectric layer (paragraphs [0016]-[0017]);

and incorporating nitrogen into the dielectric layer to substantially yield the nitrogen profile corresponding to the established non-stoichiometry (para. [0018]).

12. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(a) the invention was known or used by others in this country, or patented or described in a printed publication in this or a foreign country, before the invention thereof by the applicant for a patent.

13. Claims 1-2, 8-12, and 18 are rejected under 35 U.S.C. 102(a) as being anticipated by Khamankar (US 2003/0109146 as above).

With reference to Fig. 3, the reference anticipates the claims in that it discloses a method of fabricating a semiconductor device, comprising:



establishing a non-stoichiometry associated with a dielectric layer, the non-stoichiometry associated with a degree, the degree of the non-stoichiometry corresponding to a nitrogen profile associated with the dielectric layer; controlling deposition of the dielectric layer outwardly from a substrate to substantially yield the established non-stoichiometry of the dielectric layer (paragraphs [0016]-[0017]);

and incorporating nitrogen into the dielectric layer to substantially yield the nitrogen profile corresponding to the established non-stoichiometry (para. [0018]).

14. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

15. Claims 1-18 and 20 are rejected under 35 U.S.C. 102(b) as being anticipated by Werkhoven et al. (US 2001/0041250 A1).

The reference anticipates the claimed invention in that it discloses a method of forming a graded dielectric film comprising:

establishing a graded dielectric layer of silicon oxynitride, wherein O content varies from 0% to 66%, and N content varies from 0% to 57% (Fig. 7 and related text).

forming, by atomic layer deposition (ALD) process, the graded silicon oxynitride outwardly from a substrate by controlling the flowing of silicon and oxygen ; and incorporating nitrogen into the dielectric to substantially yield the nitrogen profile corresponding to the established graded silicon oxynitride (para. [0055], [0064]-[0069]).

Note that the graded silicon oxynitride is a non-stoichiometric silicon oxynitride since stoichiometric silicon oxynitride has formula  $\text{Si}_2\text{N}_2\text{O}$  (see para. [0051] of US 2004/0191151 A1. The document is cited merely for showing this fact but not applied in the rejection). Thus, the graded silicon oxynitride of the reference anticipated the claimed limitation “non-stoichiometry associated with a dielectric layer”.

For claims 2, 3, 8, 12, 13, and 18, Fig. 7 shows each of depositing cycle 301b-301d is determined to have a proportion of silicon concentration relative to oxygen of the graded dielectric layer, the proportion corresponding to the concentration profile of the established silicon oxynitride depicted in Fig. 8.

For claims 4-5, 14-15, Fig. 7 and paragraphs [0067]-[0068] disclose repetition of depositing cycles, each cycle corresponds to the flow of silicon during the first pulse to deposit silicon outwardly from the substrate and oxidizing the silicon during the second pulse.

For claims 6 and 16, each full monolayer 102-114 (Fig.6) is formed after a plurality of cycles and each cycle corresponds to a pair of silicon source gas and oxidant source gas pulse (para. [0073]). Thus, the deposition of each silicon oxynitride monolayer involves a number of first silicon pulses and a number of second oxidant pulses. Alternatively, when the dielectric layer 72 is considered as a whole, the formation of layer 72 involves the repetition of a plurality of silicon pulses and oxygen pulses as illustrated in Fig. 7.

For claims 7 and 17, see paragraphs [0064]-[0065] for the silicon and oxidant flow rates and pressures associated with the silicon and oxygen concentrations (Fig.7) that results in the silicon and oxygen concentration profile (Fig.8) of the graded silicon oxynitride.

For claims 9-10, see paragraph [0073] for the thickness of each of full monolayer 102-114 or paragraph [0083] for the thickness of the resultant silicon oxynitride 72.

For claim 20, every limitation of the claim has already been addressed with respect to claims 1-18 noted above.

### ***Double Patenting***

16. Claims 1-2, 8-12 and 18 are provisionally rejected under the judicially created doctrine of obviousness-type double patenting as being unpatentable over claim 18 of copending Application No. 10/061,637 (US Pub. 2003/0109146 as above).

Although the conflicting claims are not identical, they are not patentably distinct from each other because of the followings:

Claim 18 of the copending application recites forming a non-stoichiometric silicon oxide layer comprises  $\text{Si}_x\text{O}_y$  and wherein a ratio of  $y/z$  is less than two. The action to form the non-stoichiometric silicon oxide corresponds the pending claimed limitation “establishing a non-stoichiometric associated with a dielectric layer”. Moreover, the determination of the ratio  $y/z$  less than two reads on the pending claimed limitation “controlling deposition of the dielectric layer” because if the formation of the  $\text{Si}_x\text{O}_y$  were not controlled, the ratio  $y/z$  of less than two would not be obtained. Finally, the nitridation step of claim 18 reads of the pending claimed limitation “incorporating nitrogen”.

This is a provisional obviousness-type double patenting rejection because the conflicting claims have not in fact been patented.

### *Claim Rejections - 35 USC § 112*

17. The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

18. Claims 4-7 and 14-17 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

Each of claims 4-7 and 14-17 recites the limitation “the flowing” that renders

the claim ambiguous because one cannot ascertain what "flowing" the claim is referring to.

19. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Trung Dang whose telephone number is 571-272-1857. The examiner can normally be reached on Mon-Friday 9:30am-6:00pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Olik Chaudhuri can be reached on 571-272-1855. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

Trung Dang  
Primary Examiner  
Art Unit 2823

11/17/04

